



# South Pole Ice Core Project (SPICEcore)

*What has been accomplished, what is below 1751 m, and synergies with the new Hercules Dome project*



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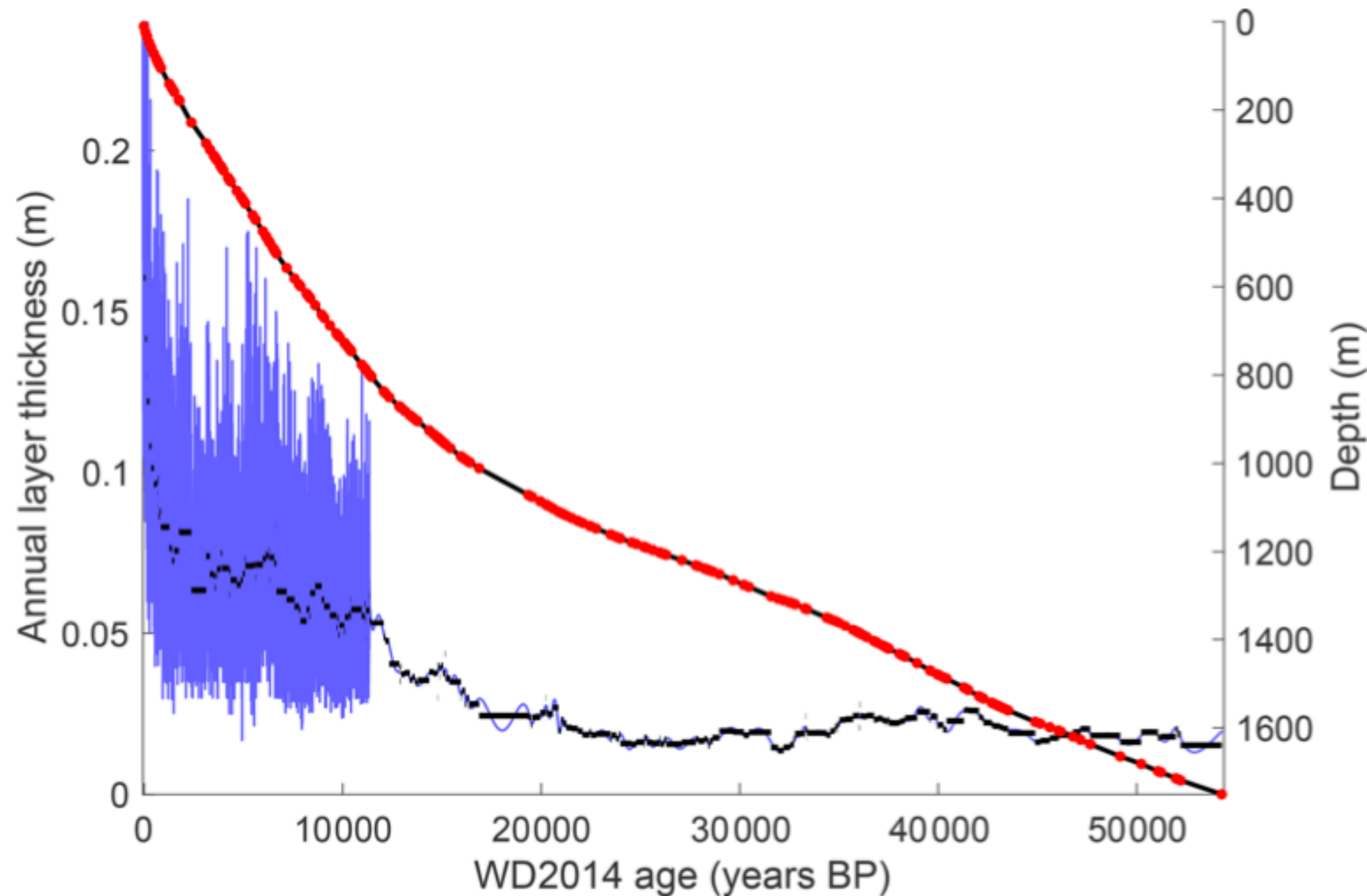


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# SPICEcore was a community project

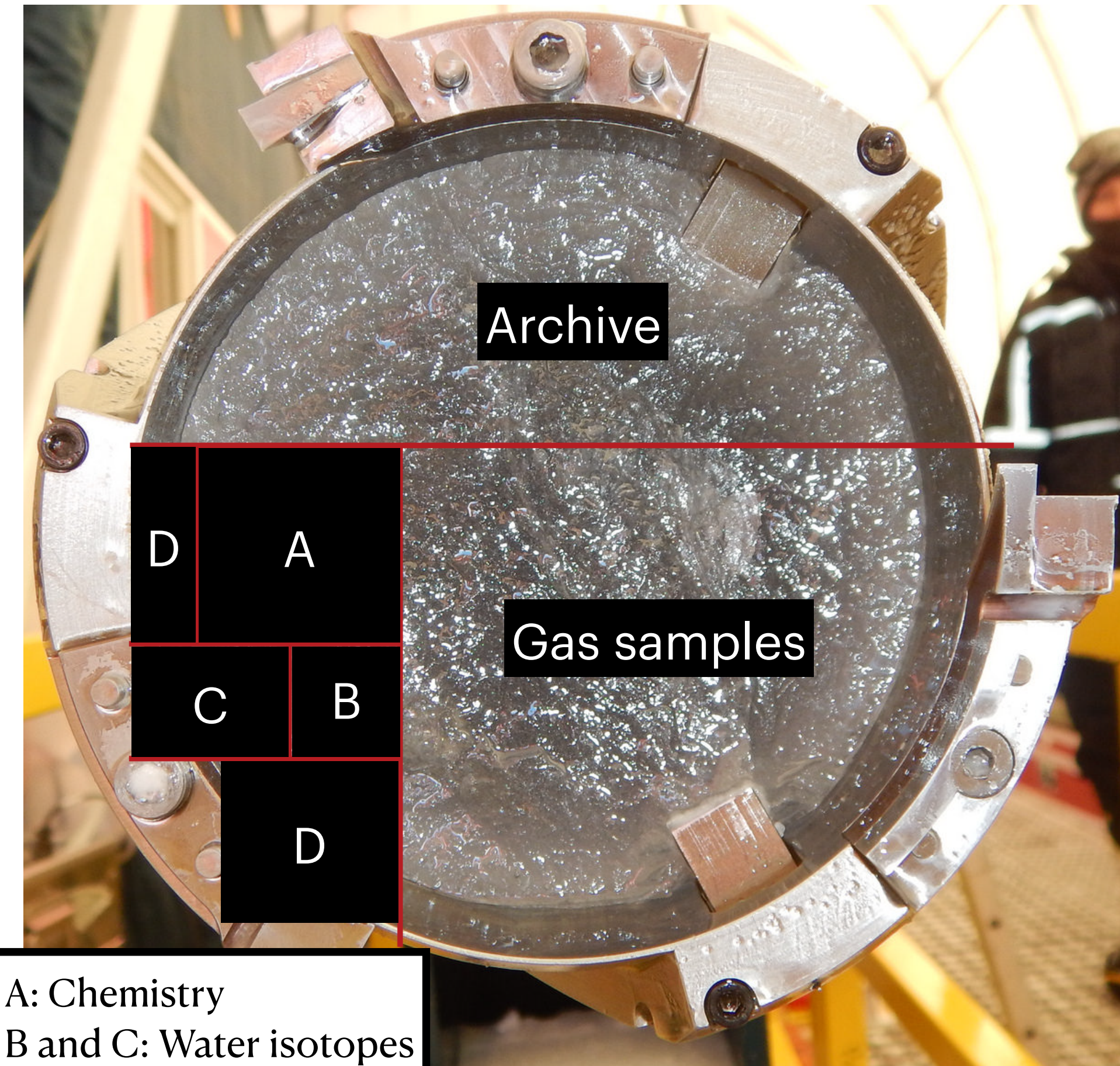


- Ice age at 1751 m is 54.3 ky (right y-axis)
- Chronology tied to very high resolution WAIS Divide ice core using volcanic events (red tie-points)
- Annual layers (left y-axis) visible through the Holocene (purple line), which allowed visual stratigraphy based dating
- Annual layers (decadal smooth) are ~ 2cm/y or higher through 1751 m: high resolution for East Antarctica

Figure from Winski et al., *Clim. Past*, 2019

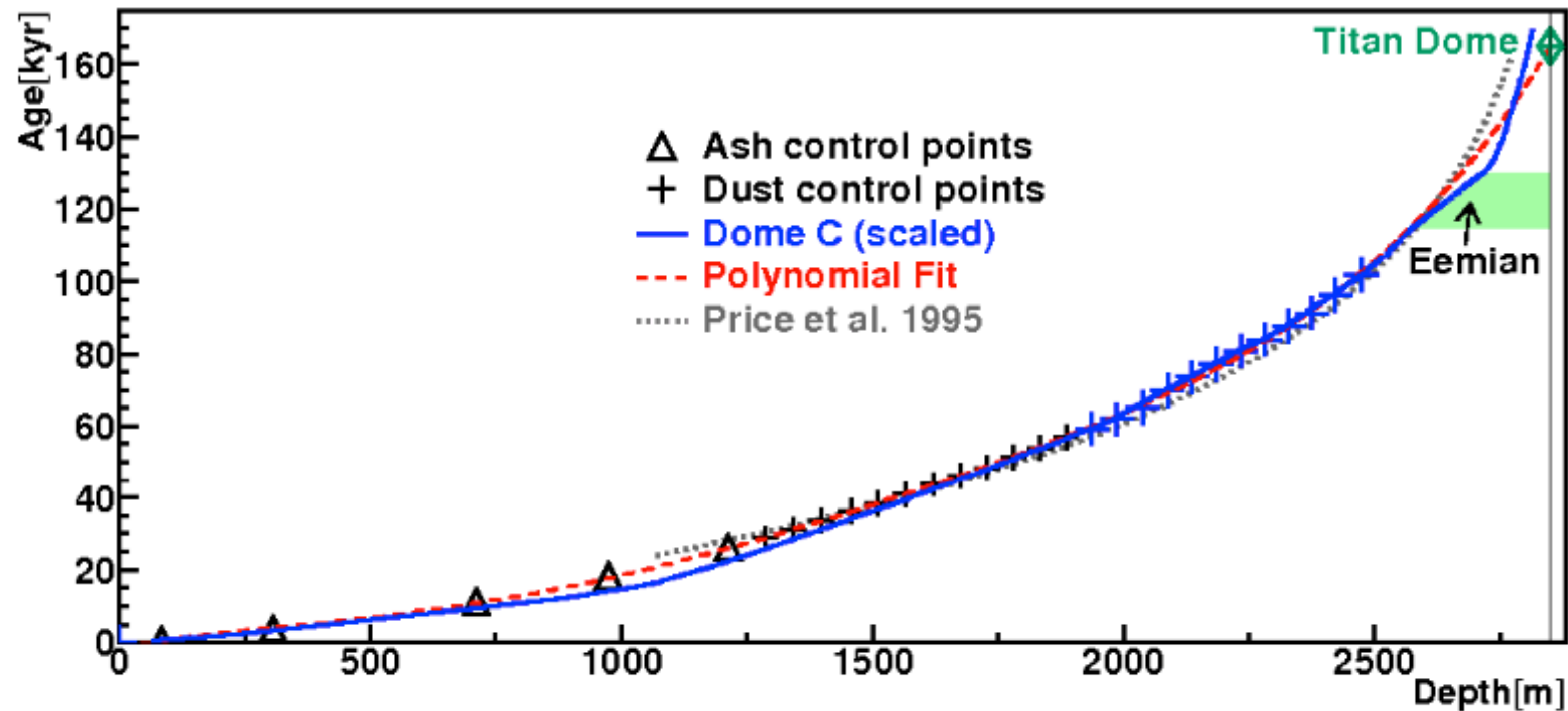
# SPICEcore measurements (so far)

- SPC14 (name of the ice core) was drilled to 1751 m in two seasons.
- More than 10,000 samples have been cut and analyzed.
- Measurements include water isotopes, variety of gases, major ion chemistry, particle dust, physical properties, volcanic tephra,  $^{10}\text{Be}$ .
- 50% of the gas and 100% of the archive cross-sections are preserved in NSF Ice Core Facility in Denver for future needs.



A: Chemistry  
B and C: Water isotopes  
D: Berilium-10

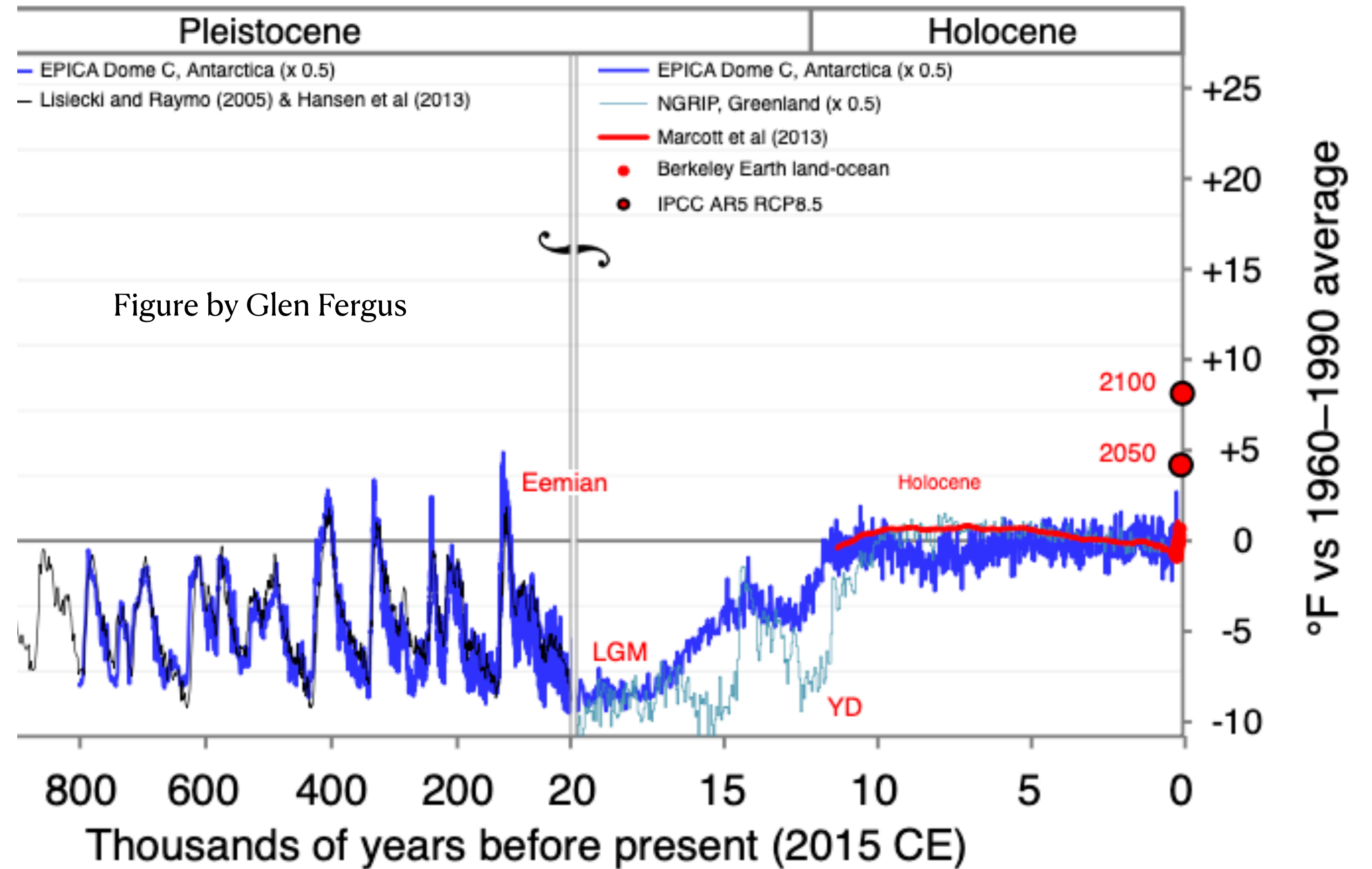
# What is below 1751 m?



- Bedrock near the SPICEcore site is close to 2850 m.
- Modeling suggests there is ice dating back to the Eemian (Last Interglacial Period) below 1751 m; however, more work is needed to increase confidence.
- Amanda/IceCube dust data (pre-SPICEcore) suggested undisturbed layering through at least 2500 m.
- There is nothing in the SPICEcore results so far that contradicts intact stratigraphy as depicted from dust data.

# Why is Eemian (Last Interglacial) important?

- During the Eemian, global temperatures and sea-level were probably higher than today.
- Eemian might be a good analogue for the warmer future climate.
- We want detailed, high-resolution records of all climate-related variables of the Earth System since the Eemian

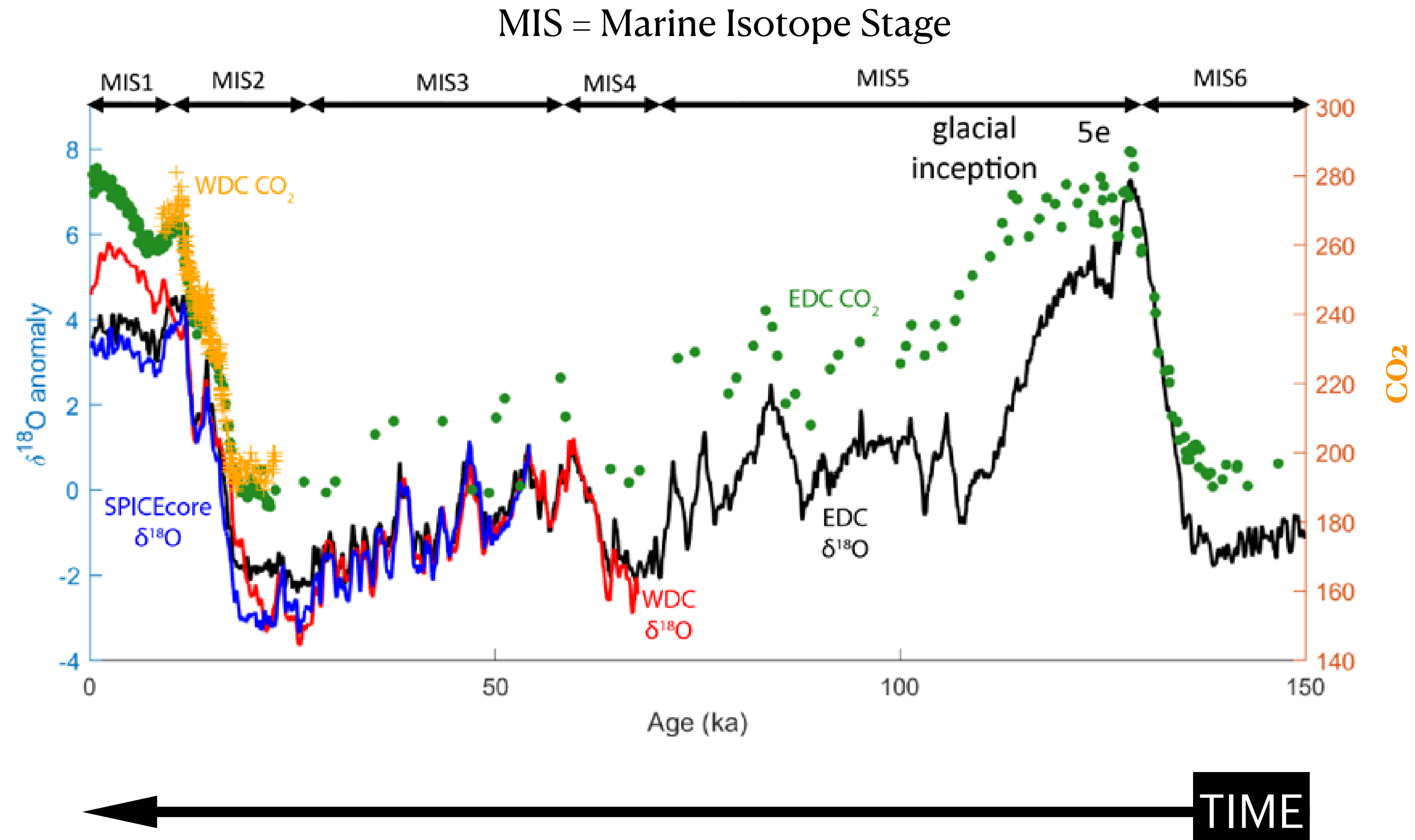


TIME



# Why is Eemian (MIS5e) important?

- U.S. does not have quality ice older than 70 ky (no MIS5 or MIS6 ice).
- Existing measurements (non-U.S. ice cores) from MIS3 through MIS6 provide less than ideal resolution (e.g. CO<sub>2</sub> shown in the figure).
- Large volumes of high quality ice delivers: Improved resolution, better quality measurements, better constraints on glacial/interglacial T change



# Hercules Dome (HD) is the new community project

HD is on the edge of the Transantarctic mountains overlooking the West Antarctic Ice Sheet

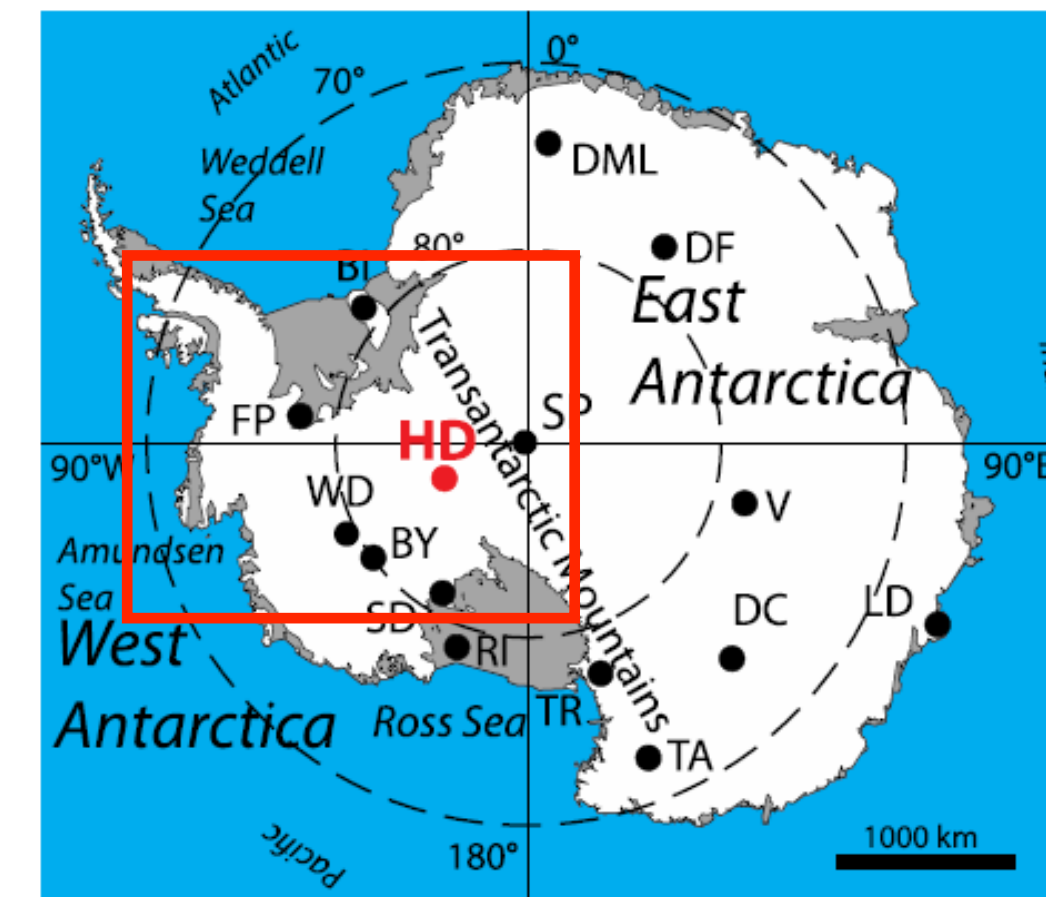
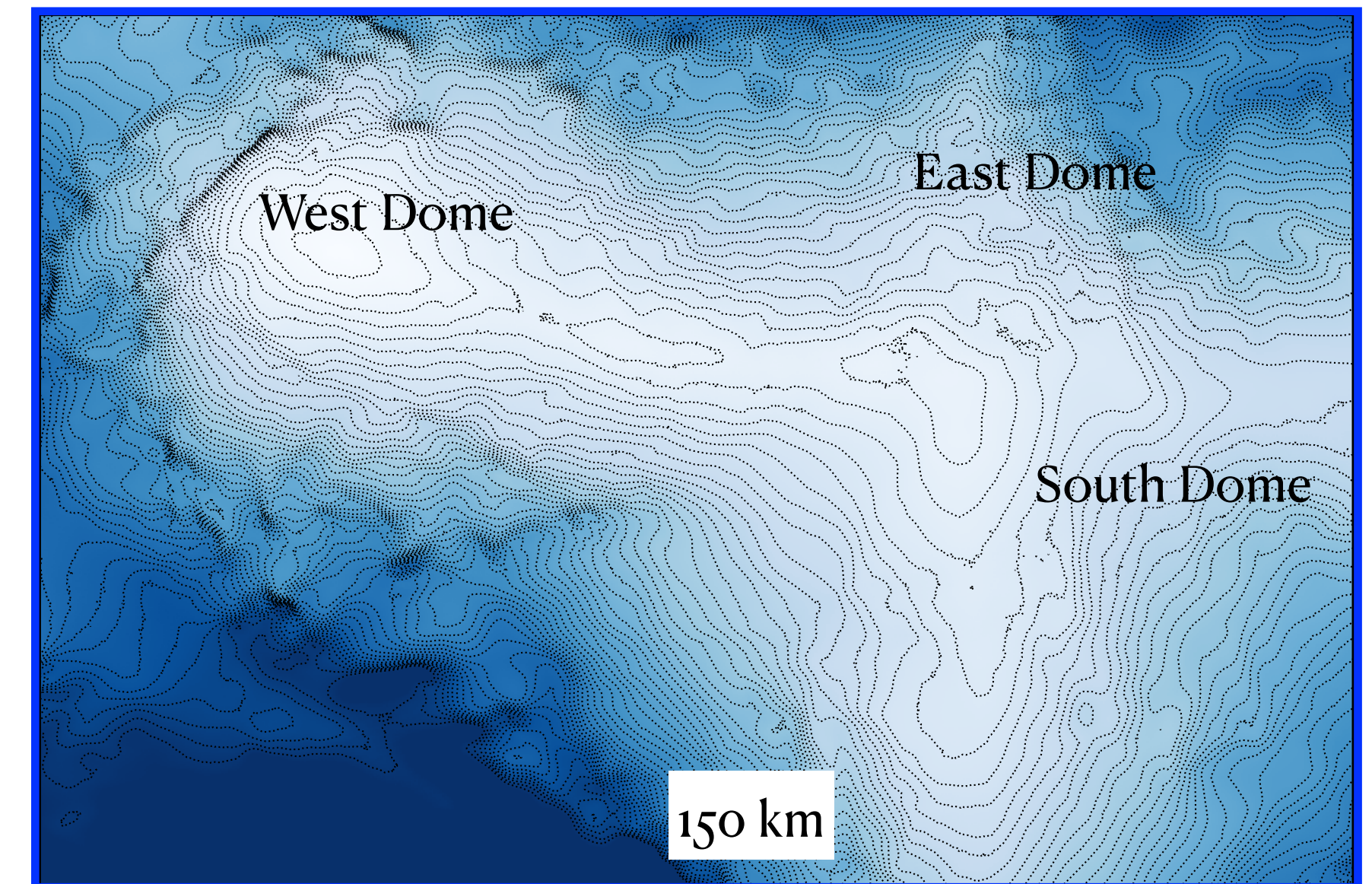


Figure: Ben Hills



# HD ice core will provide critical paleoclimate information

## GOALS

- Retrieve high quality ice to bedrock
- Recover an Eemian climate record (water isotopes) from this location
  - Proximity of Hercules Dome to West Antarctica is key to understanding how smaller WAIS was during the Eemian (see Figure)
- HD will be first continuous US ice core through the Eemian
  - Improve upon existing ice core records (e.g. CO<sub>2</sub> and dust) and introduce new measurements (noble gas isotopes, trace gases)

*Did the West Antarctic Ice Sheet collapse during the Eemian?*

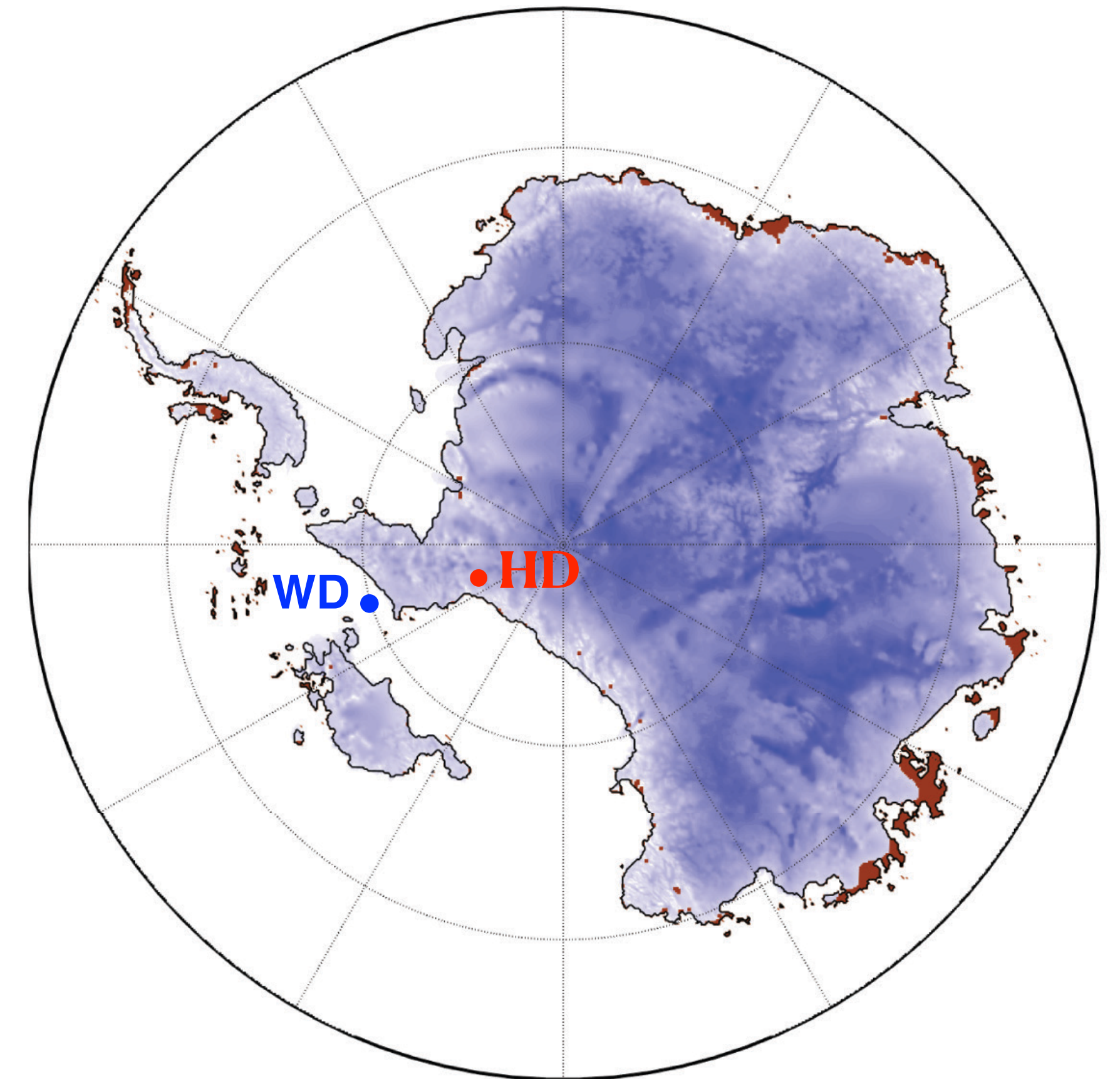
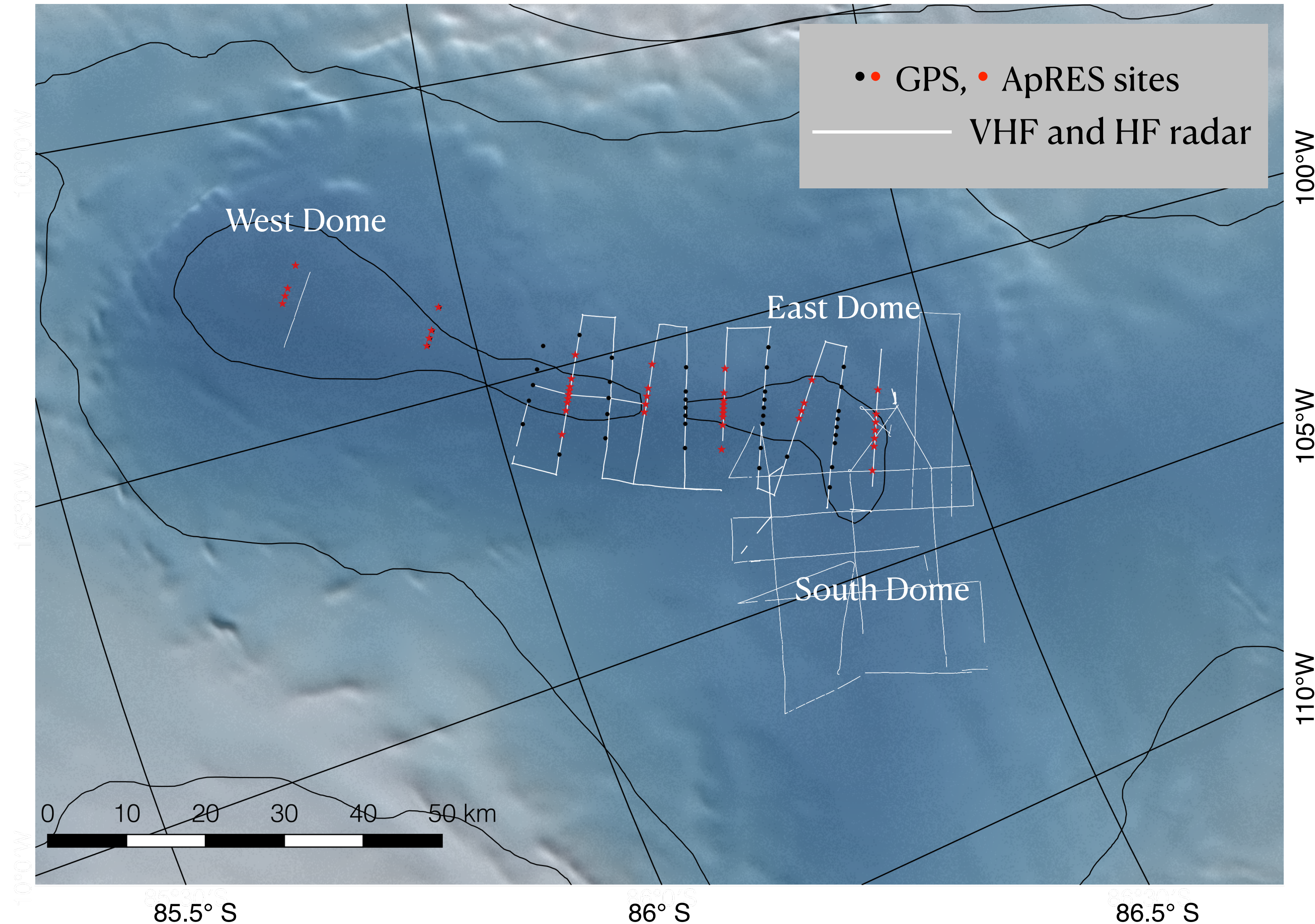


Figure: Deconto and Pollard, 2016



# Hercules Dome Project Outlook

- Site surveys conducted in 2019/2020 and more to come in 2021/2022
- Looks like both the West and South Domes are good drilling sites with Eemian ice present
- Bedrock < 2000 m
- Best case scenario in the field: Traverse, camp set-up, and begin drilling in 2023/2024
- Community building workshops starting this spring



Thanks to the 2019-2020 field team: Knut Christianson, Nick Holschuh, Ben Hills, Annika Horlings, Andrew Hoffman, Gemma O'Connor, John Christian

# Hercules Dome and South Pole

*What are the possible synergies?*

- **Eemian ice likely present at both sites**
  - *Possibility to study Eemian climate signal from Hercules Dome and Titan Dome area*
- **SPICEcore project science included improved (higher resolution) and new (trace and inert gases) measurements that will also be used for the Hercules Dome project**
  - *Possibility of verification with multiple ice cores*
- **Ice covering the last 100-150 ky from two East Antarctic ice cores would facilitate a lot of new and exciting science**
- **VISIT [herculesdome.org](http://herculesdome.org) TO STAY IN TOUCH**
  - *Announcement about first workshop coming soon*